

## A LONGITUDINAL PSYCHO-PHYSIOLOGICAL STUDY OF ACTIVE AND INACTIVE MEN

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### ABSTRACT

After an interval of ten years, physically active and inactive male university teachers were re-examined across four measures; predicted maximum oxygen uptake, percentage body fat, personality and attitudes towards physical activity. Both groups showed a decrease in predicted oxygen uptake and an increase in body fat although the active subjects continued to possess higher predicted maximum oxygen uptake values and have a lower percentage body fat than the inactive subjects. In general the psychological assessments revealed no major changes but minor shifts in attitudes towards physical activity were noted.

**Key words:** Physical activity, Predicted maximum oxygen uptake, Body fat, Personality and Attitudes

### INTRODUCTION

Regular physical activity by males in mid-life can positively influence their health (Morris and Gardiner, 1969; Morris et al, 1973; Fentem and Bassey, 1976). Readily observed benefits are to the cardiovascular system, through aerobic fitness and to physical form by the assistance in the maintenance of low body fat levels. Conversely, physical inactivity results in a deterioration of cardiovascular functioning, similar to that accepted as accompanying the ageing process and paralleling that which occurs with cardiovascular disease (Taylor and Montoye, 1972). Physical inactivity is also linked with high body fat levels (Mayer, 1968). Jokl (1975) suggests that the beneficial effects of regular physical activity may influence body form and function positively and offset the socially accepted, negative, physical features of ageing.

Psychological health and well-being are also influenced by physical activity. Regular participants tend to reveal the more positive and socially-favoured personality features of maturity, self-sufficiency, resourcefulness and confidence (Brunner, 1969). In addition, beneficial personality changes have been reported after physical activity regimens (Ismail and Trachtman, 1973; Ismail and Young, 1973; Merzbacher, 1979). Such changes would be dismissed by Costa, McCrae and Arenberg (1980), for they consider personality to be unmalleable, having a central core that endures throughout life.

Closely allied to personality is attitude behaviour. Little is known of physical activity attitudes and attendant motives but participants do attribute different feelings towards physical activity than non-participants. Active individuals tend to stress its physical rewards, frustration releasing vigour and long term goals of participation, whereas inactives respond to its socialising functions and the spectator-like appeals of its grace and beauty (Reid, 1976).

The methods of assessment applied in the earlier work of Reid (1973) were used to re-examine two groups of male university teachers after an interval of ten years. These were

predicted maximum oxygen uptake, percentage body fat, personality and attitudes towards physical activity. The active group had maintained a life-style which involved regular physical activity participation. In comparison the second group were physically inactive. In 1973, the active group revealed higher predicted maximum oxygen uptake and lower percentage body fat measures than their inactive counterparts. The active group also held different attitudes towards physical activity than the inactive group but the groups did not differ in personality.

Over a ten year period a decline in predicted oxygen uptake values and an increase in body fat would be expected, although they should be less pronounced among the active group. Psychologically, prediction is more difficult, for it is debatable whether personality changes can be expected or the strength and direction of any possible changes. Even more difficult to forecast are the developments in attitudes towards physical activity. Ageing theories, however, hint at both the strengthening and polarising of such attitudes over the decade.

### METHODS

The subjects were thirty male teachers from the University of Aberdeen, eighteen active (age  $44.3 \pm 3.9$  years) and twelve inactive (age  $44.2 \pm 5.3$  years). In the original study (Reid, 1973) the active subjects were selected from those teachers who were known to participate regularly in some form of physical activity in that they used the various activity areas available at the university, 2-3 times per week. The inactive subjects were selected from those teachers whose life-style clearly did not involve participation in regular physical activity. Both groups had maintained their activity life-styles over the ten years. All subjects completed both the Sixteen Personality Factor (16PF), Form A (Cattell, 1964) and the Likert version of the Attitude Towards Physical Activity (Kenyon, 1968) questionnaires. The Cattell questionnaire is well known in both personality and physical activity research. In this study its sixteen first order personality factors were combined to form the second order factors for Extraversion (EX), Anxiety (ANX), Tough Poise (TP) and Independence (IND). The Kenyon inventory is less well known. It attempts to reveal the perceived instrumentality of physical activity. It is based on a conceptual model which characterises physical activity in terms of six sub-domains; these are physical activity as an Ascetic experience (AC), as the pursuit of Vertigo, (V) as an Aesthetic experience (AS), as a Social experience (S), as Catharsis (C) and for Health and Fitness (HF).

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Predicted maximum oxygen uptake ( $\text{VO}_2 \text{ max}$ ) values were obtained by using the sub-maximal procedures according to Åstrand-Ryhming (1954). In an attempt to improve reliability assessment was scheduled over three days (Williams, 1975). Subjects undertook a six-min cycle ergometer ride at the same time on each of three consecutive days. Days one and two were for habituation purposes. The final work rate was that which induced a steady state heart rate of close to  $150 \text{ beat} \cdot \text{min}^{-1}$  during the fifth and sixth min of the third ride. Maximum oxygen uptake was predicted from the final heart rate response during the final work rate.

Before the second ergometer ride body weight was obtained and percentage body fat (% Fat) was estimated, using the procedures outlined by Durnin and Rahaman (1967). The means of three skinfold measures, taken at four sites (biceps, triceps, sub-scapular and supra-iliac) were totalled and subjected to a regression equation for the prediction of body density. Body fat estimates were calculated using Siri's (1956) equation. Twenty-eight subjects (sixteen active and twelve inactive) completed the physical assessments in this 1983 study compared with thirty-seven (twenty active and seventeen inactive) in 1973.

## RESULTS AND DISCUSSION

Mean scores for predicted oxygen uptake and percentage body fat for the activity groups at both testing times are shown in Table I. Similarly, mean scores on the four second-order personality factors and six attitudes towards physical activity sub-domains are shown in Table II.

A one-way analysis of variance (ANOVA) was carried out on the physiological and psychological data. Table III shows the ANOVA F-ratios and the significant ( $p < 0.05$ ) Scheffé test comparisons. Table IV displays the significant ( $p < 0.05$ ) coefficients from Pearson product-moment correlation analyses performed on the 1983 data.

### Predicted Oxygen Uptake and Body Fat

Significant differences were found between the activity groups in predicted oxygen uptake and percentage body fat ( $p < 0.05$ ). Observation of the data revealed a decline in predicted oxygen uptake and an increase in percentage

**TABLE I**  
Predicted maximum oxygen uptake ( $\text{VO}_2 \text{ max}$ ) and percentage body fat scores for active and inactive subjects in 1973 and 1983 (mean  $\pm$  SD)

Activity Group	Physiological Data	
	Predicted $\text{VO}_2 \text{ max}$ $\text{ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$	% Body Fat
Actives 1973 $n = 20$	$52.8 \pm 7.9$	$10.1 \pm 2.3$
Inactives 1973 $n = 17$	$43.7 \pm 7.3$	$14.5 \pm 2.8$
Actives 1983 $n = 16$	$46.9 \pm 10.5$	$12.6 \pm 2.4$
Inactives 1983 $n = 12$	$37.2 \pm 5.9$	$18.2 \pm 3.6$

**TABLE III**  
Differences between activity groups and over time:  
ANOVA F-Ratios and Scheffé Comparisons.  
Abbreviations as Table II

Variable	F-Ratio	Scheffé Test Comparisons			
		1-2	3-4	1-3	2-4
$\text{VO}_2 \text{ max}$	9.32***	*	*		
% Fat	23.49***	*	*		*
EX	0.42				
ANX	0.55				
TP	3.78*				
IND	1.71†				
AC	7.67***	*			
V	2.04†				
AS	0.41				
C	12.79***	*	*		
S	0.47				
HF	13.86***	*	*		

- 1 = Actives 1973  
2 = Inactives 1973  
3 = Actives 1983  
4 = Inactives 1983
- Significance for F-Ratios and Scheffé Test Comparisons are:  
†  $p < 0.20$   
\*  $p < 0.05$   
\*\*\*  $p < 0.001$

body fat for both actives and inactives over the ten years but this was only statistically significant ( $p < 0.05$ ) in the case of the inactives' body fat scores. Care should be taken about extrapolating these results to a wider population. In this

**TABLE II**  
Personality and attitude towards physical activity scores for active and inactive subjects in 1973 and 1983 (mean  $\pm$  SD)

Activity Group	Personality Factors				Attitude Towards Physical Activity					
	EX	ANX	TP	IND	AC	V	AS	C	S	HF
Actives 1973 $n = 20$	5.8 $\pm 1.5$	4.9 $\pm 1.5$	7.2 $\pm 2.0$	7.4 $\pm 1.6$	39.0 $\pm 8.6$	38.7 $\pm 11.5$	40.7 $\pm 6.4$	42.7 $\pm 8.2$	37.5 $\pm 6.6$	42.8 $\pm 6.8$
Inactives 1973 $n = 20$	5.5 $\pm 1.8$	5.6 $\pm 1.6$	5.8 $\pm 1.7$	6.6 $\pm 1.8$	27.8 $\pm 7.0$	33.1 $\pm 8.7$	39.2 $\pm 11.1$	30.4 $\pm 7.5$	35.4 $\pm 7.6$	30.6 $\pm 8.9$
Actives 1983 $n = 18$	5.9 $\pm 1.5$	5.2 $\pm 1.4$	6.9 $\pm 1.9$	7.5 $\pm 1.5$	36.3 $\pm 9.5$	37.7 $\pm 10.8$	39.6 $\pm 4.7$	42.9 $\pm 7.7$	35.8 $\pm 6.6$	42.9 $\pm 6.8$
Inactives 1983 $n = 12$	5.2 $\pm 2.1$	5.1 $\pm 1.3$	5.3 $\pm 1.7$	6.5 $\pm 1.7$	30.8 $\pm 6.0$	31.4 $\pm 7.8$	42.0 $\pm 5.0$	34.5 $\pm 5.9$	37.4 $\pm 5.1$	33.2 $\pm 6.4$

Key:— Extraversion (EX)  
Anxiety (ANX)  
Tough Poise (TP)  
Independence (IND)  
Ascetic experience (AC)  
Pursuit of Vertigo (V)  
Aesthetic experience (AS)  
Social experience (S)  
Catharsis (C)  
Health and Fitness (HF)

TABLE IV

Significant Pearson Product-Moment Correlation Coefficients for the 1983 Data. Abbreviations as Table II

Actives 1983			Inactives 1983		
$\dot{V}O_2$ max/% Fat	$r = -0.57$	AC/V	$r = 0.72$	C/HF	$r = 0.81$
V/S	$r = -0.49$	AC/C	$r = 0.61$	S/HF	$r = 0.70$
V/TP	$r = 0.58$	V/S	$r = 0.74$	S/EX	$r = 0.81$
C/HF	$r = 0.71$	V/HF	$r = 0.77$	HF/EX	$r = 0.60$
		V/EX	$r = 0.63$	EX/ANX	$r = -0.66$
		C/S	$r = 0.70$	AGE/ANX	$r = 0.64$

Correlation coefficients are significant at the 5 per cent level

work, however, the active group revealed significantly higher predicted oxygen uptake values than the inactive. Over the decade the inactives' predicted levels decreased by 14.9% (43.7 to 37.2 ml.kg<sup>-1</sup>min<sup>-1</sup>) whereas the actives showed a reduction of 7.4% (52.8 to 46.9 ml.kg<sup>-1</sup>min<sup>-1</sup>). The slope of decline was not significantly different between the two groups, indicating that the results of this study are in keeping with others.

When compared with the Barr and Thompson (1978) table of desired fitness norms for the general population, the actives' maximum oxygen uptake values (mean age 44.3 years; 46.9 ml.kg<sup>-1</sup>min<sup>-1</sup>) are considerably higher than the suggested level for their 40/49 age range (40 ml.kg<sup>-1</sup>min<sup>-1</sup>). They also compare very favourably with the 18/29 age range norm (43 ml.kg<sup>-1</sup>min<sup>-1</sup>). In contrast, the inactives (mean age 44.2 years; 37.2 ml.kg<sup>-1</sup>min<sup>-1</sup>) are in keeping with the desirable level for males aged between 50/59 years.

At 12.6% the actives carry a significantly smaller percentage of their body weight as fat, compared to the inactives who showed 18.2%. The inactives' percentage body fat level does not differ markedly from that considered appropriate for the 40/49 years age range (18%) and the 50/59 years age range (19%) (Barr and Thompson, 1978). In comparison the actives' 12.6% places them advantageously close to the 13% recommended for males aged 18/29 years. In addition, it shares similarity with the 13.2% for active middle-aged males reported by Lewis et al (1975).

The actives' data yielded negative relationships between predicted maximum oxygen uptake and percentage body fat ( $r = -0.57$ ) indicating that those with the highest predicted maximum oxygen uptake scores also tended to be the leanest.

Collectively, the predicted maximum oxygen uptake and body fat results support the beneficial claims made for regular participation in physical activity. It would, however, be reckless to suggest that these two factors alone are important, for it is clear that many bio- and socio-cultural features also play a significant part. Nevertheless, the inference from this work is that in these two features, arguably the more overt of the physical ageing process, the decline is less evident among regularly active men. Put in simplistic terms, in the two physical areas investigated, the active sample appeared to be some ten years less old than those who are inactive with regard to body fat and maximum oxygen uptake.

Ochsner (1976) cited physical inactivity and increased

body weight as two of the principal factors responsible for accelerating the ageing process. This study suggests, biologically at least, that regular participation in physical activity over a ten year period influences maximum oxygen uptake (as measured by sub-maximal prediction) and body fat, in such a way as to decelerate the general conceptual, yet socially accepted, pace of ageing in these physical areas.

### Personality Measures

Significant differences were not observed, either between actives and inactives or over time, on the four personality second order factors, extraversion, anxiety, tough poise and independence ( $p > 0.05$ ). Studies based on sports participation (Ogilvie, 1967; Warburton and Kane, 1967 and Harris, 1973) plus popular theory, constantly imply that physical activity involvement is linked with higher than usual levels of extravert behaviour. This study, however, reveals no more than average scores on this dimension. The physiological measures associated with physical activity involvement (higher levels of predicted maximum oxygen uptake and lower levels of body fat) were not related to extraversion. A possible hint of things to come, however, may be seen in the positive significant correlation ( $r = 0.64$ ,  $p < 0.05$ ) between age and anxiety revealed by the inactives, for the actives showed no such relationship. This study data, therefore, suggests some agreement with Costa, McCrae and Arenberg (1980), for participation or non-participation in physical activity combined with the passage of time, has not influenced significantly the measured personality traits of these subjects.

### Attitudes Towards Physical Activity

The actives differed significantly from the inactives by scoring the Cathartic and Health/Fitness domains higher ( $p < 0.05$ ). This was the major distinguishing feature between the two groups. Differences were not observed between groups on the Vertigo, Aesthetic, Social and Ascetic attitude domains ( $p > 0.05$ ). That the actives also ranked the Health/Fitness and Cathartic domains in first and second positions respectively, indicates that they conceptualise physical activity primarily as the promotion of health and fitness which at the same time induces some emotional release. In support of this notion is the positive significant correlation between the Health/Fitness and Cathartic domains ( $r = 0.71$ ).

In 1973, the Ascetic domain was viewed very differently by the two groups for the actives scored significantly higher than the inactives. This was not evident ten years later. Although neither group showed a statistically significant change towards the Ascetic during the intervening period, the mean scores increased for the inactives but decreased for the actives. Both groups also ranked the Ascetic domain lowly. Thus, the notion that the conceptual cornerstone of physical activity participation is hard physical work for future rewards, finds little support among these subjects. At this stage, therefore, attitudes held towards the Ascetic are not a major distinguishing feature between the two groups.

Both groups scored the Aesthetic domain in a similar way. This, plus the lack of relationship with other study measures, suggests that the grace and beauty of physical movement and involvement is seen in some type of activity isolation by both groups. Ranked in first place, the Aesthetic dimension appear to be the major conceptual feature of the inactives' attitude toward physical activity. This result is

worthy of comment. Although scored at similar levels it is clear that the apparent similarity of views in this domain are arrived at from different vantage points and experiences. The inactives lack recent participatory experience, which implies that their attitudes have developed through vision or distant memory. In contrast, by the very nature of their regular involvement, the actives' responses are likely to be formulated in conjunction with their activity, "feeling by doing". A similar argument can be made in respect of the Vertigo and Social dimensions, which are scored in the same way by both actives and inactives.

The actives, therefore, conceive the psycho/physical function of physical activity to be centred on Health/Fitness and Cathartic features which in some combined way becomes the core of their involvement. Closely related are the Aesthetic features of their participation. Although scored less highly, the inactives also sense this Health/Fitness and Cathartic core element. This may, in part, identify a fundamental difference between the two groups, for the inactives' perceptions arise not through present experience but from past involvement ( schooldays or national service, etc.). This notion would lend support to the belief that the crucial period for establishing interest in physical activity, as a part of lifestyle, is in youth and during the transition to adulthood (Stiles, 1967; Cratty, 1967).

The cluster of correlations exhibited by the inactives associating Social, Health/Fitness and Vertigo attitudes with the trait of Extraversion is in keeping with the popular view of personality and physical activity participation. These study results indicate that the more extraverted non-participants hold more positive attitudes towards physical activity relating to the thrill and spill, social and health supporting elements. A subtle link may be sensed here between this work and that of Reid (1980). In his investigation of middle-aged males, it was found that higher levels of extraversion tended to be revealed by those males who perceived physical activity as important, even though they themselves were not physically very active.

In addition there is a cluster of significant relationships ( $p < 0.05$ ) centering on the Cathartic attitude, involving the Ascetic ( $r = 0.61$ ), Social ( $r = 0.70$ ) and Health/Fitness ( $r = 0.81$ ) domains. This suggests that for the inactives, physical activity participation is viewed as a form of emotional release, which promotes both health and fitness and social interaction yet also involves some deferred gratification.

These data, therefore, begin to reveal how the males in this study, who have remained inactive during a period in social history when participation has been emphasised, conceptualise physical activity. Their framework centres on physical activity's aesthetic and social components. Its emotional and purgative features encompassing health type benefits are also understood as are the risk and thrill types of involvement. In addition the emotional and stoic features of participation that are related to an outgoing

personality are also noted. Thus for this group, who show a negative correlation between extraversion and anxiety, physical activity appears not to involve the less socially and physically bold.

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